

CLAIMS

- 1 1. A CMOS inverter comprising:
2 a heterostructure including a Si substrate, a relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer on said Si substrate,
3 and a strained surface layer on said relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer; and
4 a pMOSFET and an nMOSFET, wherein the channel of said pMOSFET and the
5 channel of said nMOSFET are formed in said strained surface layer.
- 1 2. The CMOS inverter of claim 1, wherein the heterostructure further comprises a
2 planarized surface positioned between the strained surface layer and the Si substrate.
- 1 3. The CMOS inverter of claim 1, wherein the surface roughness of the strained surface
2 layer is less than 1nm.
- 1 4. The CMOS inverter of claim 1, wherein the heterostructure further comprises an oxide
2 layer positioned between the relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer and the Si substrate.
- 1 5. The CMOS inverter of claim 1, wherein the heterostructure further comprises a SiGe
2 graded buffer layer positioned between the relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer and the Si substrate.
- 1 6. The CMOS inverter of claim 1, wherein the strained surface layer comprises Si.
- 1 7. The CMOS inverter of claim 1, wherein $0.1 < x < 0.5$.
- 1 8. The CMOS inverter of claim 7, wherein the ratio of gate width of the pMOSFET to the
2 gate width of the nMOSFET is approximately equal to the ratio of the electron mobility and the

3 hole mobility in bulk silicon.

1 9. The CMOS inverter of claim 7, wherein the ratio of gate width of the pMOSFET to the
2 gate width of the nMOSFET is approximately equal to the ratio of the electron mobility and the
3 hole mobility in the strained surface layer.

1 10. The CMOS inverter of claim 7, wherein the ratio of gate width of the pMOSFET to
2 the gate width of the nMOSFET is approximately equal to the square root of the ratio of the
3 electron mobility and the hole mobility in bulk silicon.

1 11. The CMOS inverter of claim 7, wherein the ratio of gate width of the pMOSFET to
2 the gate width of the nMOSFET is approximately equal to the square root of the ratio of the
3 electron mobility and the hole mobility in the strained surface layer.

1 12. The CMOS inverter of claim 7, wherein the gate drive is reduced to lower power
2 consumption.

1 13. In a high speed integrated circuit, the CMOS inverter of claim 7.

1 14. In a low power integrated circuit, the CMOS inverter of claim 7.

1 15. An integrated circuit comprising:

2 a heterostructure including a Si substrate, a relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer on said Si substrate,
3 and a strained layer on said relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer; and

4 a p transistor and an n transistor formed in said heterostructure, wherein said strained
5 layer comprises the channel of said n transistor and said p transistor, and said n transistor and

6 said p transistor are interconnected in a CMOS circuit.

1 16. The integrated circuit of claim 15, wherein the heterostructure further comprises a
2 planarized surface positioned between the strained layer and the Si substrate.

1 17. The integrated circuit of claim 15, wherein the surface roughness of the strained layer
2 is less than 1nm.

1 18. The integrated circuit of claim 15, wherein the heterostructure further comprises an
2 oxide layer positioned between the relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer and the Si substrate.

1 19. The integrated circuit of claim 15, wherein the heterostructure further comprises a SiGe
2 graded buffer layer positioned between the relaxed $\text{Si}_{1-x}\text{Ge}_x$ layer and the Si substrate.

1 20. The integrated circuit of claim 15, wherein the strained layer comprises Si.

1 21. The integrated circuit of claim 15, wherein $0.1 < x < 0.5$.

1 22. The integrated circuit of claim 15, wherein the CMOS circuit comprises a logic gate.

1 23. The integrated circuit of claim 15, wherein the CMOS circuit comprises a NOR gate.

1 24. The integrated circuit of claim 15, wherein the CMOS circuit comprises an XOR gate.

1 25. The integrated circuit of claim 15, wherein the CMOS circuit comprises a NAND gate.

1 26. The integrated circuit of claim 15, wherein the p-channel transistor serves as a pull-up
2 transistor in said CMOS circuit and the n-channel transistor serves as a pull-down transistor in

3 said CMOS circuit.

1 27. The integrated circuit of claim 15, wherein the CMOS circuit comprises an inverter.